EE4208: COMPUTER GRAPHICS FOR ENGINEERS

Effective Term
Semester B 2023/24

Part I Course Overview

Course Title
Computer Graphics for Engineers

Subject Code
EE - Electrical Engineering
Course Number
4208

Academic Unit
Electrical Engineering (EE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA2001 Multi-variable Calculus and Linear Algebra
and
(CS2311 Computer Programming
or
equivalent)

Precursors
EE2331 Data Structure and Algorithms or equivalent

Equivalent Courses
Nil

Exclusive Courses
EE5808 Topics in Computer Graphics

Part II Course Details

Abstract

The aim of this course is to provide students with an understanding of the principles, concepts, and techniques of computer graphics from an engineering viewpoint.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Apply 3D object representation techniques to build up a graphics scene		x	x	
2	Model and view articulated objects by hierarchical structuring techniques and coordinate transform		x	x	
3	Apply lighting, shading and rasterization techniques to create a 2D image		x	x	
4	Apply texture mapping and animation techniques		x	x	
5	Create an animation or a game using computer graphics		x	x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Key concepts are described and explained Key concepts are illustrated by examples and programming exercises Each student does a project creating their own original animation or game using techniques learnt in the course	1, 2, 3, 4	3 hrs/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tests (min.: 2)	1, 2, 3, 4	30	
2	#Assignments (min.: 3)	1, 2, 3, 4, 5	20	

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

Remarks:
To pass the course, students are required to achieve at least 30% in course work and 30% in the examination.

may include mini projects, in-class assignments, and homework assignment

Assessment Rubrics (AR)

Assessment Task

Examination

Criterion

Achievements in CILOs

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Coursework

Criterion

Achievements in CILOs

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

Introduction
Graphics pipeline. Graphics applications.Commercial graphics libraries and packages.

Three Dimensional Object Representations
Object representation methods such as polygon mesh, superquadrics, sweep representation, constructive solid geometry, splines, fractals, and particle systems.

Three Dimensional Geometrical and Modelling Transformation
Homogeneous coordinates. Linear transformations. Composite transformations.
Coordinate system transformations. Hierarchy of transformations and level of details.

Three Dimensional Viewing
Viewing coordinate system. Transformation from world to viewer Coordinates. Parallel and perspective projection. Clipping.

Illumination Models and Surface Rendering
Light sources. Reflections: ambient, diffuse, specular. Polygon rendering methods: flat, Gouraud, Phong. Texture mapping. Bump mapping Image based rendering. Colour Models. Shadow generation on plane. Shadow mapping.

Visible Surface Detection
Back face culling. Z-buffer Algorithm. Ray Casting.

Animation
Key frame and parameterised systems. Morphing. Physical motion simulation.

Reading List

Compulsory Readings

	Title
1	D. Hearn, M.P. Baker, W.R. Carithers, Computer Graphics with OpenGL, 4th Edition, Pearson (2011).

Additional Readings

	Title
1	E. Angel, D. Shreiner, Interactive Computer Graphics: A Top-down Approach with Shader-based OpenGL, Addison-Wesley (2012).
2	A. Watt, 3D Computer Graphics, Addison-Wesley (2000).
3	G. Sellers, R. S. Wright, N. Haemel, OpenGL Superbible: Comprehensive Tutorial and Reference, Addison-Wesley (2014).